ABSTRACT

This project was conducted to evaluate the effects of land use and water management practices on the hydrology and water quality for a large, poorly drained agricultural watershed in the Albemarle - Pamlico Estuarine Study area. A 5329 ha watershed representative of the region was selected for this modelling study. The hydrology of the agricultural fields was simulated using a version of DRAINMOD modified to account for lateral seepage losses from canals influenced by control structures. Average annual effluxes of nutrients (NO_3-N, TKN, and TP) from the fields were calculated using the drainage volumes predicted by DRAINMOD and nutrient concentration estimates determined from previous research. The total outflow of water and nutrients were predicted for the existing watershed and for a variety of other scenarios using alternate water management and land use practices. The medium scale watershed model, FLDNSTRM was used to determine the peak outflow rates from a 2126 ha section of the watershed under various water management practices. DRAINMOD simulations for the watershed predicted that the average annual total drainage under existing conditions would be 14.5 million m^3 of water (27 cm over the entire area). The simulations predicted that average annual effluxes of nutrients would be: 24 t/yr for NO_3-N, 23 t/yr for TKN, and 2.2 t/yr for TP. Control drainage practices on all of the agricultural land would reduce drainage from the watershed by 28 % and NO_3-N efflux from the watershed by 48 to 58 % when compared to the agricultural land with no control drainage practices. Control drainage practices would reduce TKN efflux from the agricultural lands by 23 to 29 %. Improved subsurface drainage would increase NO_3-N efflux by 138 to 249 % when compared to the existing unimproved subsurface drainage conditions. Improved subsurface drainage would decrease TKN efflux by 7 to 15 % and when used in combination with unimproved surface drainage would decrease TP efflux by 27 to 31 %. The volume of drainage water from the watershed was greater from the land developed for agriculture than from natural forest land, except when a high level of control was practiced on the agricultural land. The efflux of nutrients was greater from the agricultural land than from forest land particularly for NO_3-N on all soil types and for TP on deep organic soils. The FLDNSTRM simulations showed that peak flow rates at the outlet of a 2126 ha section of the watershed were reduced by 27 to 49 % when compared to the cumulative peak inflow rates from the individual fields. Improved subsurface drainage reduced peak outflow rates by 7 to 12 % compared to unimproved subsurface drainage. Control drainage increased peak outflow rates by less than 8 %. The total water and nutrient outflow predicted by the simulations should be considered conservative (ie. higher than measured) since total water outflow predicted by the simulations were generally lower than those observed in field experiments and since the simulations do not consider nutrient removal that occurs in the ditches and canals. Land use and water management practices affect the hydrology and water quality for large, poorly drained agricultural watersheds. These practices can be used to reduce the cumulative impacts of agricultural development in the A/P Study area.